Circle 522

Frequency-Selective Gain Increases Dynamic Range Of An Active Antenna

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This much-improved version of the "High-Gain Broadband Active Antenna" (ELECTRONIC DESIGN, *Jan. 6, 1997, p. 164)* features wider bandwidth and lower noise at half the power consumption and a fraction of the cost (the IC complement here costs about $1.20 versus $10 for the previous version). But its most important difference is a method of coping with the problem that plagues all active broadband antennas: How to achieve high gain for weak shortwave signals without being overloaded by the local medium-wave broadcast transmitters.

The figure-eight polar pattern of an electrically short dipole has sharp nulls, allowing you to null out on-frequency interference by rotating a short dipole antenna. However, the output impedance of an electrically short dipole is too high to drive a receiver directly.

Therefore, dual FET source followers are used to present a high impedance to the antenna elements, and provide power gain to drive the LM733 integrated circuit. This, in turn, supplies voltage gain to compensate for the small capture area of the antenna elements. The toroidal transformer that follows provides differential-to-single-ended conversion and impedance matching to the 75-Ω load. Moreover, it multiplexes the output signal and dc supply voltage on the coax connecting the antenna unit with the power supply/receiver end of the system (where another circuit separates power and signal).

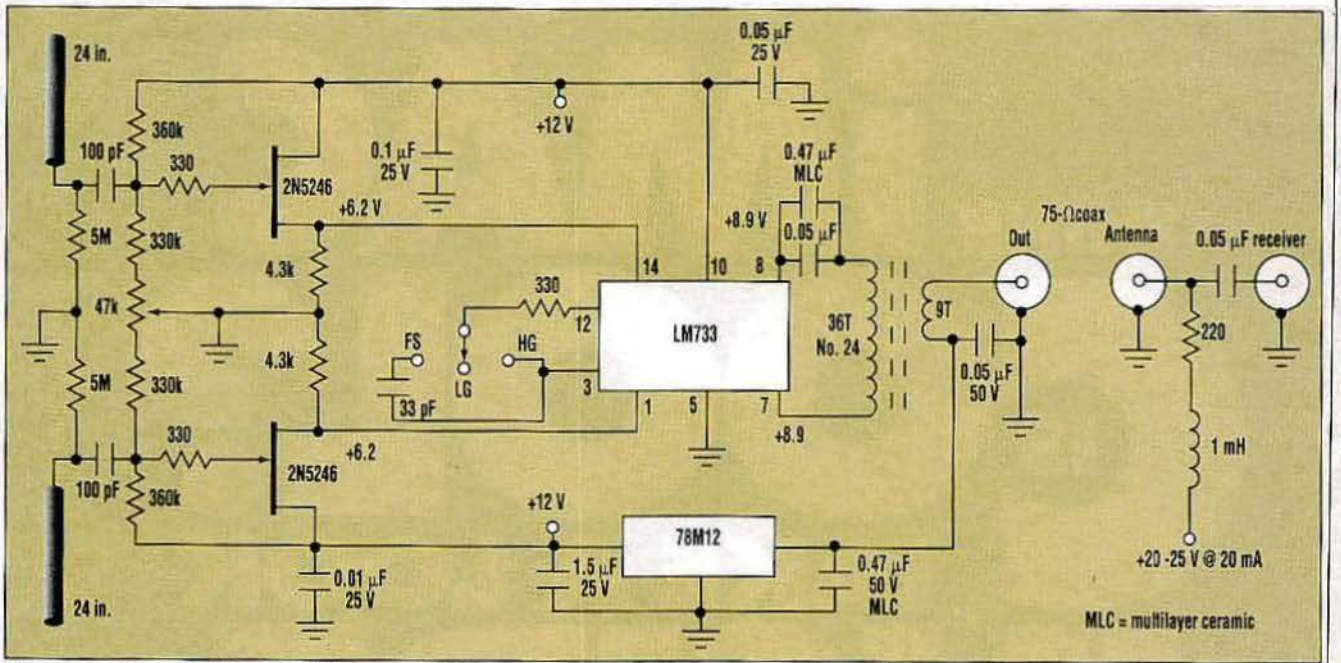
To facilitate this multiplexing, the circuit is configured for single-ended operation by biasing the LM733 inputs (pins 1 and 14) at approximately 6 Volts. Total power requirement is 20 mA when using a 20-25 V dc supply.

The circuit gain is selectable by a subminiature center-off SPDT toggle switch to suit the local RF environment (see the figure). For strong-signal areas, the low gain (9 dB) position is best. When all signals are weak, the standard high gain (HG) setting (19 dB) should be selected. But, to receive weak shortwave signals where the local MW broadcast stations are strong, use the frequency-selective (FS) gain position. Here, the gain curve slopes from 9.9 dB at 1.6 MHz to 19 dB at 25 MHz, so you get high shortwave amplification with simultaneously low medium-wave amplification.

The frequency response at low gain is very flat (±0.2 dB) from 200 kHz to 35 MHz, and is only 0.4 dB down at 60 MHz. At standard high gain, the response is very flat to 25 MHz and –3 dB at 50 MHz. The maximum output level in all gain configurations is over 500 mV rms into a 75-Ω load.

A matched pair of high-frequency low-capacitance FETs, such as the 2N5246 with an I_{DSS} of about 3 mA, is the best choice for the input stage. It's important to minimize the input capacitance by using miniature carbon-film resistors and minimal board footprints for the gate connections.

The toroidal transformer's primary is 36 turns of No.24 enameled wire wound on a core from a Sony 1-421-302 line choke. Its secondary is nine turns of No.24 telephone wire. The antenna elements are two 24-in. lengths of 3/8-in. thin-walled aluminum tubing (old TV antenna elements are ideal). The 50k trim pot should be adjusted for equal clipping of the output signal peaks at just past maximum output.



This improved version of the "High-Gain Broadband Active Antenna" from a previous Idea For Design has much wider bandwidth and lower noise, at half the power consumption and a fraction (approximately 12%) of the original parts cost.